Pest Management Grants – Demonstration Final Report

Title:	**Demonstrating Reduced Risk Management Practices for Pests of Ornamental Cropping Systems**
Agreement Number:	00-0203S
Principle Investigators:	**Karen L. Robb, Ph.D**., University of California Cooperative Extension, County of San Diego **Heather Costa, Ph.D.**, Department of Entomology, University of California, Riverside **Julie P. Newman**, University of California Cooperative Extension, Counties of Ventura and Santa Barbara
Contractor Name:	Regents of the University of California
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Acknowledgements:

Key personnel:

Karen L. Robb, Ph.D.
University of California Cooperative Extension, County of San Diego
5555 Overland Avenue, Building 4
San Diego, CA 92123
858-694-2857 (phone) 858-694-2849 (fax) klrobb@ucdavis.edu

Julie P. Newman
University of California Cooperative Extension, County of Ventura
669 County Square Drive, #100
Ventura, CA 93003
805-645-1459 (phone) 805-645-1474 (fax) jpnewman@ucdavis.edu

Heather S. Costa, Ph.D.
Department of Entomology
University of California
Riverside, CA 95251
909-787-4733 (phone) 909-787-3602 (fax) heather.costa@ucr.edu

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Executive Summary

The actual numbers of reduced risk pesticides available to ornamental plant growers today is unparalleled. However, in many cases these materials cannot be used in the same manner as conventional pesticides, such as organophosphates or carbamates once were. Insecticide resistance is an even greater risk with many of these new materials, compared to the conventional materials, so their use must be limited on each crop. Because the materials now used in ornamental production are 'softer', they are also not always as efficacious as conventional materials, which is problematic for production of aesthetic crops with low thresholds for damage. It is imperative that growers use as many IPM tools as possible to prolong the effective life of the new chemistries and to accommodate the lower efficacy of some of the 'softer' products.

Until recently, most ornamental plant growers believed that physical exclusion could only be accomplished by screening greenhouses. Our previous work with reflective mulches and plant covers in asters indicated that these strategies could reduce the numbers of insects attacking field-grown crops and may also reduce the incidence of disease transmission.

Trials were conducted to ascertain the impact of reflective mulch and reflective plant covers on the movement of insects into field-grown solidago and chrysanthemum crops. Treatments included bare ground, reflective mulch, reflective plant cover, and the combination of the reflective mulch and plant cover. In the chrysanthemum trial, an additional treatment of dark mulch as a mulch control was also included. In both crops, the impact of the reflective mulch alone was obscured once the crop reached approximately 60% canopy.

Reflective plant covers alone or in combination with reflective mulch treatments reduced the numbers of whiteflies, leafminers, and thrips moving into solidago. No negative impacts on yield or plant quality were observed, and in winter, a positive increase was observed in plant height and weight on solidago.

Thrips, the most important insect attacking chrysanthemums due to their ability to transmit tospoviruses, were also reduced on the chrysanthemums in the treatments with reflective plant covers. There was no detectable tospovirus throughout the trial, so the impact of these treatments on virus transmission could not be assessed. In the chrysanthemum trials, however, the treatments with reflective plant covers actually had increased numbers of whiteflies. No negative impacts were observed on yield or quality of the chrysanthemums at harvest and crop height was higher with all treatments compared to the bare ground. Further trials will be needed to elucidate the impact of these reflective materials on tospovirus transmission by thrips.

Thrips were also the main insect pest targeted in the hot pink trap trials. Tsuchiya et al. 1995 reported a significant preference by western flower thrips for hot pink in mandarin oranges. Industry standards for ornamental crops are blue or yellow for thrips. In these trials, however, significantly more thrips were trapped on the blue traps, than either

yellow or pink traps. Significantly more leafminers and whiteflies were captured on yellow traps than either blue or pink traps, and there were no significant differences between trap colors for aphids or fungus gnats. These results dictated that blue remain the color of choice for petunia indicator plant stations. No advantage to using pink for sticky traps or topsovirus petunia indicator plant stations was determined.

Adoption of resistance management strategies by growers and PCAs has been extremely positive. Ten years ago, most ornamental plant growers were still in the routine of using only one pesticide until it was no longer effective, partly because they often only had one effective pesticide for a target pest. Currently, there are more pesticides registered for use in ornamentals than have been available for years. However, many of the new chemistries are very susceptible to the development of resistance and growers have increasingly recognized the need for resistance management strategies. When discussing pesticide control methods, growers now regularly ask what steps they should take to avoid the development of pesticide resistance. A major focus has been educating growers and PCAs about the different strategies used for combating insecticide/acaricide resistance as opposed to fungicide resistance. Informal surveys at some of the workshops and seminars after the training indicated that 90% of the participants were instituting resistance strategy programs or altering their existing programs based on the information presented.

Results gathered from these trials was disseminated through workshops, seminars, posters, tours and newsletters, for growers, PCAs and farm advisors. This information was also presented to the scientific community through posters and invited presentations at state and national professional society meetings. More than 900 people attended workshops, tours and seminars; and five more presentations are scheduled. More than 2000 growers receive the newsletter, CORF News, which published research information.

Introduction

The actual number of reduced risk pesticides available to growers today is unparalleled. However, in many cases these materials cannot be used in the same manner as conventional pesticides, such as organophosphates or carbamates, once were. Because the materials now used in ornamental production are 'softer', they are not always as efficacious as conventional materials, which is problematic for production of aesthetic crops with low damage thresholds. Insecticide resistance is a greater risk with many of the newer insecticides, so their use must be limited on each crop. It is imperative that growers use as many IPM tools as possible in conjunction with pesticide resistance strategies to prolong the effective life of the new chemistries and to accommodate the lower efficacy of some of the 'softer' products.

Our overall goal in this project was to demonstrate to growers that adoption of monitoring programs, implementation of IPM strategies that deter insects from production areas, and stewardship of reduced risk and 'softer' pesticides result in economic control of pests.

Project Objectives

1) Evaluate the efficacy of reflective/metallic materials, reported to repel insects from field and greenhouse situations, when used as ground covers or plant covers, or as an alternative to fine mesh screens in greenhouse structures.

Initially, we intended to evaluate alternative greenhouse coverings as well as field materials, but our cooperating grower went out of business, and no suitable substitute site was found during the period of these trials.

Field Trials

Major pests of floriculture crops include western flower thrips, silverleaf and greenhouse whiteflies, leafminers, aphids, worms and mites. A survey of insecticide/ acaricide use in ornamental crops found that 47% of total insecticide dollars are spent for control of aphids, thrips, and whiteflies (1996 Maritz Marketing Service, St. Louis, MO). Indeed, western flower thrips control alone can account for 7.5% of total production costs (Murphy et al. 1998).

Until recently, most growers believed that physical exclusion could only be accomplished by screening greenhouses. However, field grown crops can also be protected using plant covers such as spun-bonded polyester 'floating' row covers (Natwick and Durazo 1985, Perring et al. 1989, Webb and Linda 1992, Costa et al. 1994, Orozco-S et al. 1994, Farias-Larios et al. 1996). In certain vegetable crops, Summers and Stapleton (1998) demonstrated reflective mulches prevented colonization by Homopterous insects. In our previous work with field grown asters (Newman 2000) populations of Homopterous insects and thrips were also reduced. This project aimed to demonstrate the use of reflective materials as mulches or plant covers to reduce pest population levels in additional field-grown ornamental crops.

Plastic mulches and plant covers with reflective surfaces were evaluated in a commercial chrysanthemum field in Oceanside, California. Each 30 foot plot consisted of three adjacent rows; data were collected only from the center of the middle row to avoid any edge effect.

Treatments used in the chrysanthemum trials were reflective ground cover, reflective plant cover, a combination of the reflective ground mulch with the reflective plant cover, non-reflective ground mulch and control of uncovered ground. Treatments in the solidago trial consisted of reflective ground cover, reflective plant cover, a combination of the reflective ground mulch with the reflective plant cover, and control of uncovered ground. The treatments were replicated three times in both trials. Insect levels were determined by counting a one inch vertical strip on one yellow sticky trap from the center of each treatment plot. Five plants were randomly selected from the center of each plot each week. Three leaves were removed, one bottom, one middle, and one top leaf, from each plant, in addition to a tap of the terminal growth. All insects found were recorded. Monthly measurements of light, air and soil temperature and plant quality (on a 1-5 scale) were also recorded for each plot. At the end of the trial, ten plants were randomly selected from each plot and evaluated for quality, plant height, fresh weight and dry weight. Chrysanthemums were also evaluated for number of flowers and caliper of terminal flowers. Data was square root or log transformed and analysed using either ANOVA or Kruskall-Wallis ANOVA.

2) Demonstrate the efficacy of using trap crops such as buckwheat on the perimeter of fields and greenhouses to reduce the movement of insects into crops.

There are plants, such as buckwheat, that are extremely attractive to western flower thrips, but do not host tospoviruses. We had planned to plant buckwheat on the perimeter of tospovirus sensitive fields, and to release predators of the western flower thrips into the buckwheat. Populations of thrips were to be monitored, so that judicious applications of pesticide could be made if the thrips populations got too high in the buckwheat. This strategy was designed for crops such as ranunculus, which can tolerate extensive feeding by western flower thrips without obvious damage, but are sensitive to tospoviruses. Thrips can only transmit tospoviruses if they acquire virus by feeding on infected plants as immature thrips. If they do acquire the virus as an immature thrips, they can transmit the virus through adulthood. Since the buckwheat is not a host of tospoviruses, developing thrips would not acquire the virus. Thrips preference for buckwheat over other crops and weeds should have reduced transmission of the virus into the susceptible crop.

Populations of western flower thrips were monitored in both buckwheat and adjacent ranunculus, as well as in ranunculus with the trap crop using weekly evaluations of yellow sticky traps. Petunia indicator plants were used to determine differences between populations of tospovirus infectious thrips between treatments. Tospovirus levels were determined for the treatments at harvest.

3) Conduct trials to substantiate reports that hot pink is a more attractive color (in comparison to yellow or blue) for trapping thrips and for increasing the attractiveness of indicator plants to thrips.

Tsuchiya et al. 1995 demonstrated a significant preference by western flower thrips for hot pink in mandarin oranges. Industry standards for ornamental crops are blue or yellow for thrips. Trials were conducted to verify this preference in San Diego County.

Blue, yellow and hot pink traps were created by cutting disks of the appropriate color from poster boards to fit into 6 inch plastic lids. A second lid, which was covered with a thin coating of oil, was placed on top of the colored disk and held in place with binder clips. The entire trap was clipped onto 1X1 inch stakes placed throughout a blooming crop of field-grown chrysanthemum. In each trial, 10 traps of each color were evaluated in a randomized design for 24 hours. The trial was replicated five times, over 5 weeks.

After the traps were in the field for 24 hours, they were removed and returned to the lab for counting. Although western flower thrips were the target pest, numbers of leafminers, whiteflies, aphids, and fungus gnats captured were also recorded. All data were analysed using ANOVA.

4) Test efficacy of reduced risk pesticides and new pesticide chemistries for efficacy against insects and insect transmitted viruses.

Conventional pesticides currently used to control pests in greenhouses and field grown floricultural crops may eventually become unavailable due to loss of registration or become ineffective due to pesticide resistance. There are many new products being introduced to the ornamental market, but many have label restrictions and/or require resistance management strategies. The goal was to provide growers with materials and information about these materials for successful incorporation into their integrated pest management programs, while minimizing the risk to humans, the environment or non-target organisms.

Although lack of Kee Kitayama Research Foundation funding reduced the overall number of trials, evaluations were conducted on the following products:
Floramite, Heritage, Tiara, Acetamiprid, Marathon II, Conserve, Ornazin, Decree and Compass. Trials were conducted in commercial greenhouses and fields using randomised block designs.

In the course of conducting the trials, we discovered that growers realized that these products worked, but wanted workshops and seminars focussing on how to maximize the efficacy of these products while prolonging the effective life of these materials through good pesticide resistance management strategies. Therefore, this became a major focus of our workshop and outreach efforts.

5) Present the results of the above studies in a demonstration workshop, and in various written formats, for growers, farm advisors, pest control advisors, and the scientific community in an effort to increase adoption of these strategies.

Educational programs were an integral part of this project and key to the adoption of IPM programs on a large scale. Information was disseminated through presentations, and grower articles. Two peer-review publications are in preparation on this work as well.

Results

Project Objectives

1) Evaluate the efficacy of reflective/metallic materials, reported to repel insects from field and greenhouse situations, when used as ground covers or plant covers, or as an alternative to fine mesh screens in greenhouse structures.

Greenhouse trials
Our original intent was to evaluate the ability of aluminized screening to reduce pest migration into greenhouses. We had planned to take advantage of a grower's plans to construct new greenhouses to compare 1) traditional exclusion screening, 2) reflective screening with larger apertures for increased air movement into greenhouses and 3) no screening. Unfortunately, the cooperating grower went out of business before construction. We did not find a substitute suitable test set up during this project period.

Field trials – Chrysanthemums
Effects on insect populations Greenhouse whitefly population pressure from neighbouring farms was incredibly intense during this trial (Figure 1). The reflective treatments did not reduce whitefly populations on chrysanthemums in this situation. In fact, significantly more whiteflies were captured in the overhead reflective plant cover plots and the combination treatment plots than were captured in the bare ground treatment. There was no significant difference between treatments in the numbers of leafminers captured on sticky cards (Figure 2). In thrips catches, however, there were significant differences, with reflective mulch treatments having significantly few thrips than the ground treatment, and the two treatments with the plant cover had significantly fewer thrips captured than the reflective mulch treatment (Figure 3).

There were no significant differences between treatments for the numbers of immature leafminers collected in leaf samples (Table 1). The use of reflective mulch as a ground cover or a plant cover did not significantly reduce the numbers of immature whiteflies or total aphids infesting the chrysanthemums relative to the control treatment (Table 1). No tospoviruses were present in any of the plots, so no estimate of the impact the reflective materials had on tospovirus transmission could be measured.

Plant environment effects Significant differences were observed in soil temperatures and light transmission (Table 2). No significant differences between treatments were observed for fresh weight, dry weight, number of flowers, or flower caliper. Significant differences were observed in plant height; with all mulch and/or cover treatments superior to the bare ground treatment (Table 3). Significant differences were also observed in the plant quality index analysis (Table 2).

Field Trials – Solidago

Effects on insect populations Reflective plant cover or the combination of plant cover and ground mulch reduced the number of aphids, thrips and leafminers captured on sticky traps per week (Figure 4). There were no differences for whiteflies, and the ground mulch alone was no better than the untreated control for all insects caught on sticky traps. Only the combination treatment reduced the number of aphids on solidago plant samples, whereas both the ground cover and combination treatment significantly reduced the number of whiteflies relative to the control. There were no significant differences among treatments for thrips numbers on solidago and leafminer larvae were never found on solidago (Figure 5).

Plant environment effects At first (January) harvest, stems harvested from plots with the reflective plant cover or the combination of the plant cover and ground mulch were longer and heavier than stems harvested from plots without the plant covers (Figure 6), however, there was no difference in stem heights or fresh weight between the four treatments at the May harvest. On cloudy days, light levels were reduced greater than 20% underneath the reflective plant covers and temperatures averaged 0.4^{0}C cooler. However, the solidago stems grown under reflective cover were heavier and longer than those not grown under cover in January. This was a benefit, since the florists prefer the longer, heavier stems.

2) Demonstrate the efficacy of using trap crops such as buckwheat on the perimeter of fields and greenhouses to reduce movement of insects into crops.

There are plants that are extremely attractive to western flower thrips, but do not host tospoviruses. The strategy was to plant buckwheat on the perimeter of a tospovirus sensitive crop, ranunculus, and to release predators of the western flower thrips into the buckwheat. Populations of western flower thrips were monitored in both buckwheat and adjacent ranunculus, as well as in ranunculus with the trap crop using weekly evaluations of yellow sticky traps. Petunia indicator plants were used to determine differences between populations of tospovirus infectious thrips between treatments. Tospovirus levels were determined for the treatments at harvest. Throughout the duration of the trial, western flower thrips population levels were extremely low in both, and no tospovirus was detected.

3) Conduct trials to substantiate reports that hot pink is a more attractive color (in comparison to yellow or blue) for trapping thrips and for increasing the attractiveness of indicator plants to thrips.

Industry standards for ornamental crops are yellow or blue sticky traps for thrips. Tsuchiya et al. (1995) demonstrated a significant preference by western flower thrips for hot pink in mandarin oranges. If pink proved significantly more attractive to western flower thrips in flower crops, we would consider changing the color of the petunia tospovirus indicator plant stands to pink to increase the attractancy of the indicator plants.

Traps were made by cutting appropriately colored yellow, blue or hot pink discs from poster stock and clipping these behind a clear trap coated with a thin film of oil. Thirty traps, 10 per color, were placed in a random design just above crop canopy of field grown cut chrysanthemums each week for 5 weeks. Each trap was at least 30 feet from any other trap. The traps remained in the field for 24 hours, to reduce any potential fading effects on the traps. After the traps were collected, they were returned to the laboratory and the number of thrips, leafminers, fungus gnats, whiteflies and aphids on each trap were recorded. Data were analyzed using ANOVA.

4) Test efficacy of reduced risk pesticides and new pesticide chemistries for efficacy against insects and insect transmitted viruses.

Pesticides were evaluated on greenhouse and field-grown ornamental crops in randomized, replicated trials. Materials evaluated included: Floramite, Heritage, Tiara, Acetamiprid, Marathon II, Pylon, Decree, Compass, Calgreen, Conserve, and Ornazin.

One serious concern with the newer chemistries is the development of pesticide resistance. In addition to evaluating new chemistries, an emphasis was placed on providing growers and PCAs resistance management strategies to prolong the effective life of these materials. This training was provided in one on one consultations and through seminars and workshops.

Informal surveys of participants at two of the educational events found that 90% of the growers were either starting a resistance management program in their overall IPM program, or had learned information that caused them to change their current IPM/resistance management practices as a result of the educational events.

5) Present the results of the above studies to growers, farm advisors, pest control advisors, and the scientific community to increase adoption of these strategies.

Educational programs are an integral part of this proposal and a key to their successful adoption on a large scale. Dissemination of information occurred through workshops, seminars, posters, written articles and tours.

We received very positive feedback from participants at workshops and field days about the potential use of reflective materials to reduce pesticide use. However, they did share the following concerns:

- How to minimize labor costs associated with laying ground mulch and the costs of supporting and raising the overhead plant cover through the growth of the crop.
- Do the increases in crop heights observed for solidago and chrysanthemums observed in the winter crops occur throughout the year for some crops? Could this additional height be used to shorten the crop cycle in mums, e.g., to offset the increased costs of mulch and/or overhead plant covers?
- Is it possible that the overhead reflective plant covers can also decrease tospovirus transmission to these crops since thrips populations under these materials are significantly reduced? Enough to offset the price?
- What is to be done with the material after planting? Can it be recycled or reused? If it can be reused, how often?
- What is the effective life of these materials, i.e. before they start to fall apart?

Discussion

The reflective materials trials demonstrated reductions of insects, especially with the use of overhead plant covers. In both crops, the reduction of insects moving into crops with the reflective mulches was no longer observed once the crop reached about 60% canopy cover.

Although thrips were clearly impacted by the reflective plant covers, the situation with the homopteran insects was not as clear. Under the moderate pressure, as was observed in the solidago trial, the numbers of whiteflies and aphids per plant were reduced. However, under intense whitefly pressure in the chrysanthemum trial, all treatments with reflective plant covers or dark mulch had significantly higher whitefly populations than the bare ground treatment. Similarly, the number of aphids per plant was significantly higher in the chrysanthemum trial with the reflective plant cover treatment alone. Growers and PCAs are understandably reluctant to employ new IPM strategies if they have the potential to increase some of the pest problems. However, they are still interested in the strategy as western flower thrips and the tospoviruses they transmit are one of the most serious problems facing ornamental plant producers today. Unfortunately, we were unable to assess the efficacy of the reflective materials in reducing tospovirus transmission due to a lack of tospovirus amongst the crops evaluated. The most common reaction to the research information was “do more trials to clarify whether there truly is potential for increasing pest problems or if this is just an anomaly”.

The efficacy of buckwheat as a trap crop for western flower thrips and and as tool to reduce tospovirus transmission into ranunculus could not be determined due to an unusual absence of the tospovirus.

Hot pink was not preferred by western flower thrips over blue. Therefore, we did not change the color of the petunia indicator plant stands used for detecting tospovirus infective thrips from blue to pink. There was no advantage to using hot pink sticky traps for the other ornamental plant insects monitored in this trial, leafminers, whiteflies, aphids or fungus gnats, either. Thus, no modification to existing monitoring traps is recommended.

Reduced risk pesticides are more available now than they have been for decades. The bulk of pesticides currently being developed by chemical manufacturers are, in fact, reduced risk, compared to the organophosphate, carbamate and pyrethroid pesticides conventionally used by the ornamental plant industry. Most growers are more than ready to try new chemistries for control of their pests. What has been lacking is not an adoption of reduced risk pesticides, but sue of these materials in a manner that will prolong their effective life. Resistance management has been a major educational emphasis throughout this project. As a result of these efforts, many more growers are adopting the use of resistance management strategies, including rotation, and reduced use of pesticides though the utilization of good IPM techniques. Informal surveys of participants at two of the educational events found that 90% of the growers were either starting a resistance management program in their overall IPM program, or had learned information that caused them to change their current IPM/resistance management practices as a result of the educational events.

Summary and Conclusions

Due to circumstances beyond our control, we were unable to complete the work on the alternative reflective materials to reduce insect migration into greenhouses. We were also stymied in our efforts to determine the efficacy of using buckwheat as a trap crop to reduce the movement of viruliferous western flower thrips into a tospovirus sensitive crop by the unexpected lack of tospovirus during this project.

The use of reflective plant covers alone or in combination with mulch reduced insect movement into solidago. This is in agreement with previously obtained positive results on asters. The results were somewhat less clear on field-grown chrysanthemum, however. The missing element, which would have established a critical use for the reflective materials, was tospovirus. If tospoviruses had been present during the trial, we could have demonstrated the impact of reflective materials in reducing transmission of tospoviruses by thrips. The implications are that these materials would have reduced transmission since thrips populations were reduced by these treatments. However, we lack the data to make this assertion.

The use of reflective plant covers or reflective mulches had no negative impact on crop quality or yield. In fact, in the winter harvests of solidago and chrysanthemum, the crops grown under these treatments were taller, a distinct advantage to the grower, since florists pay a premium price for taller cut flowers.

Hot pink was no more attractive than blue or yellow to western flower thrips, and no more attractive than yellow to aphids, leafminers, whiteflies or fungus gnats. Therefore, we do not propose its use as a trap color or for tospovirus indicator plant stations for ornamental crops.

Several reduced risk pesticides were evaluated during this project. Ornamental plant growers have been eager to adopt new chemistries, but in general they have lacked knowledge on how to use these materials effectively and how to prolong their effective life. This is extremely important as many of the new materials have a tremendous propensity for the development of resistance. A major emphasis of this project has been education of growers and PCAs in the appropriate use of these new products.

Dissemination of the information gained through this project has been key to its success. We have presented this information to more than 900 growers, PCAs and scientists working with ornamental plant producers; at least five more presentations are planned. Informal surveys at some of the workshops and seminars after the training indicated that 90% of the participants were instituting resistance strategy programs or altering their existing programs based on the information presented.

Appendix I

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Appendix II. Figures

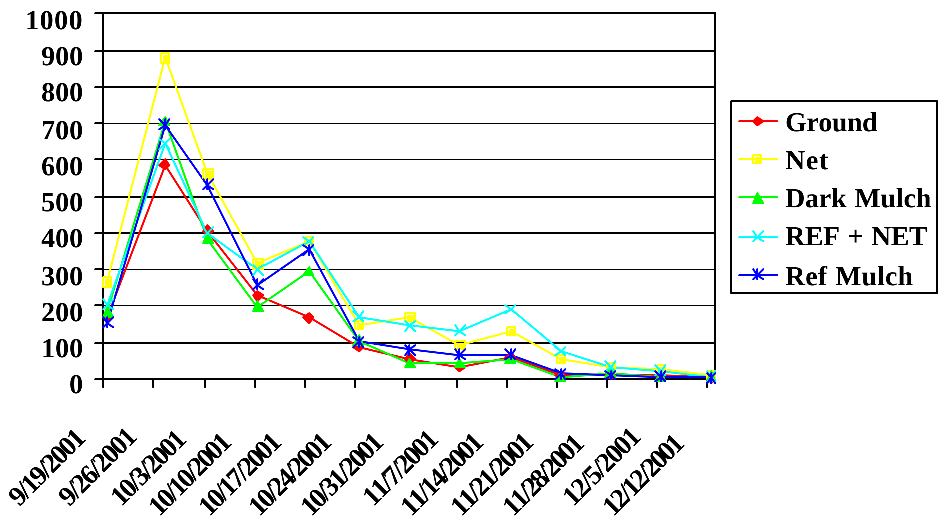

Figure 1. Mean number of whitefly adults caught on a one inch vertical strip per yellow sticky trap in chrysanthemum trial.

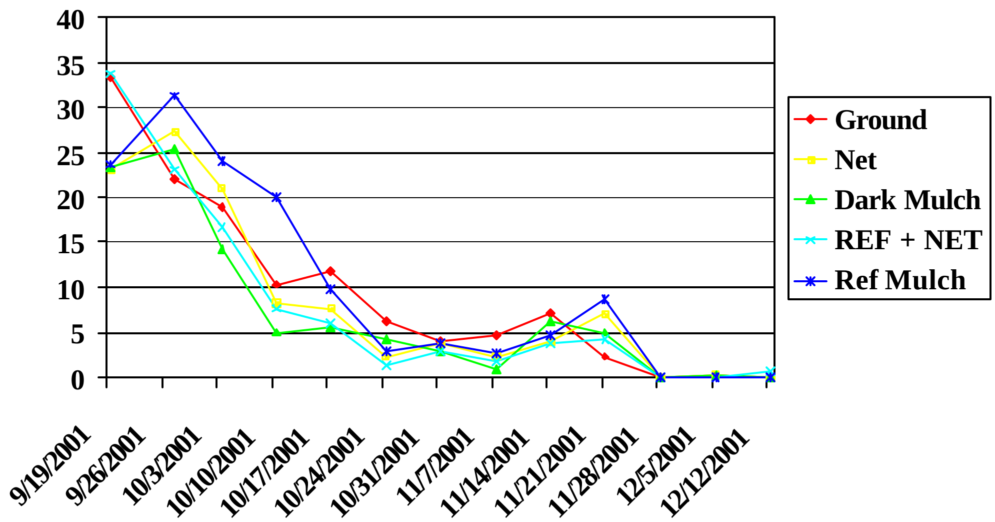

Figure 2. Mean number of adult leafminers caught on a one-inch vertical strip per yellow sticky trap in chrysanthemum trial.

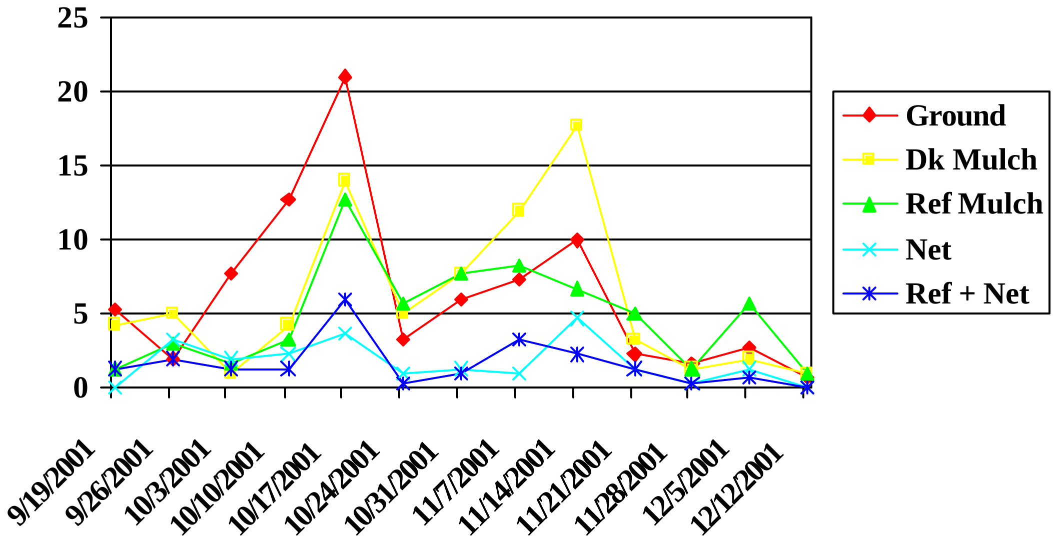

Figure 3. Mean number of adult thrips caught on a one inch vertical strip per yellow sticky trap in chrysanthemum trial.

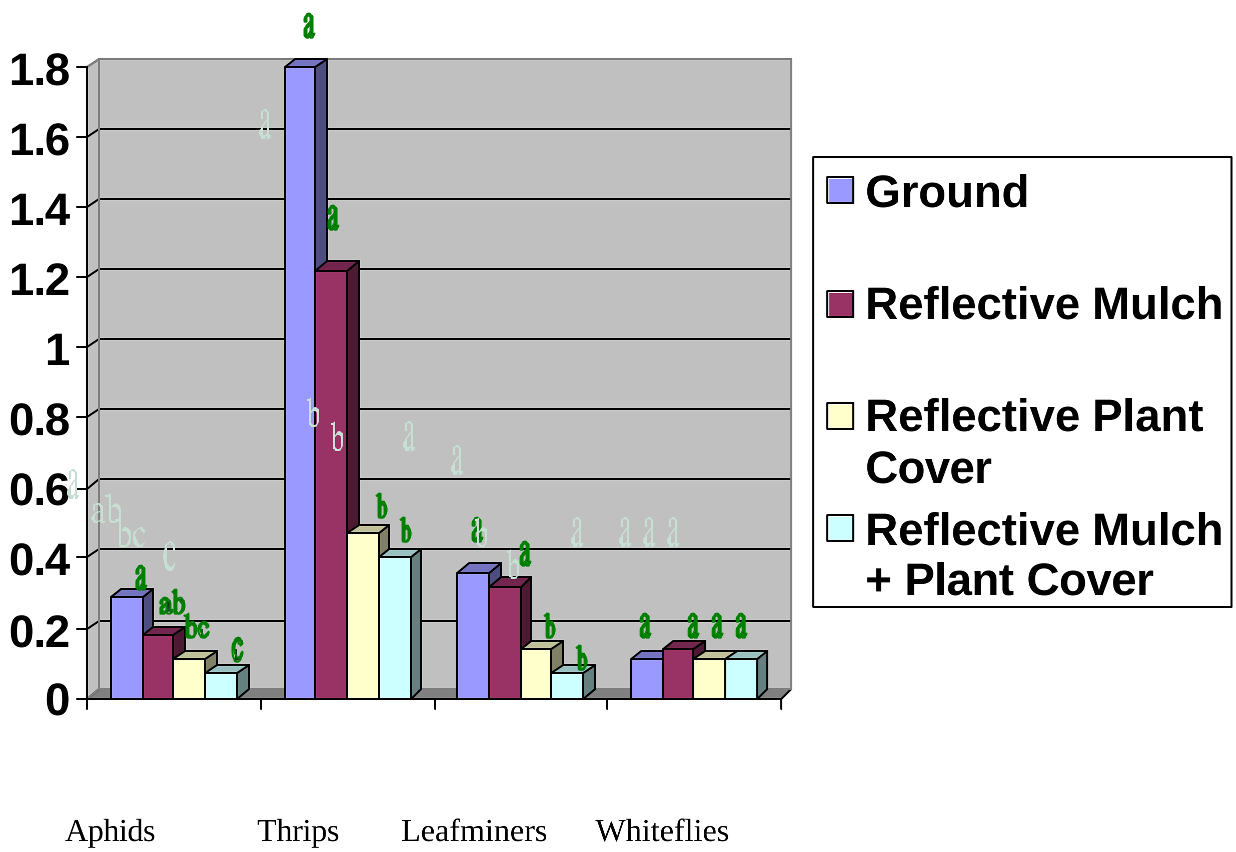

Figure 4. Mean number of insects caught per day on yellow sticky traps in solidago trial.

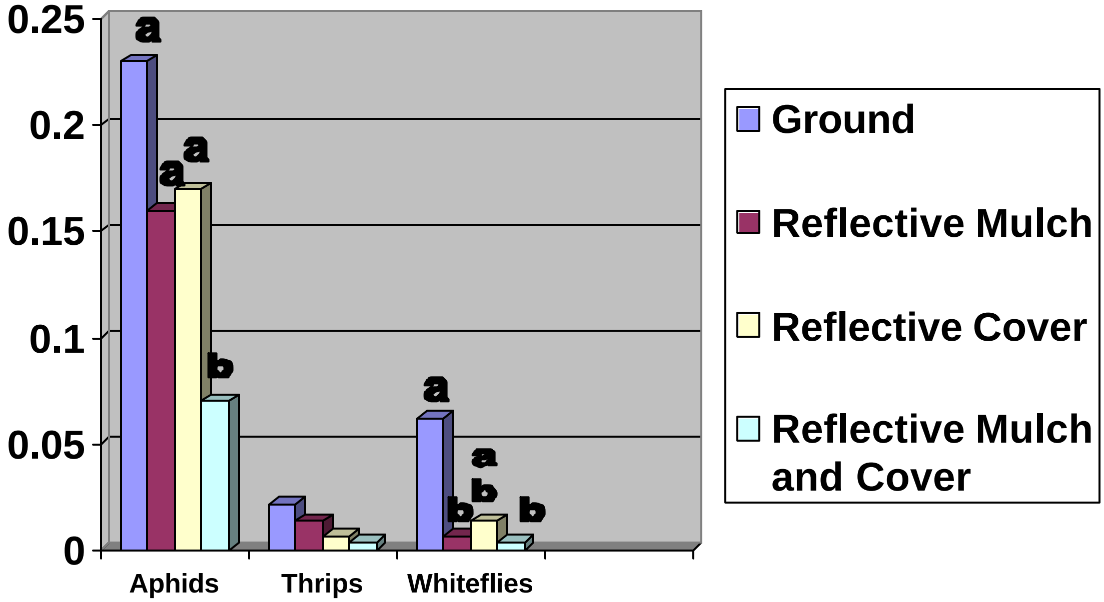

Figure 5. Mean number of insects per solidago plant sample.

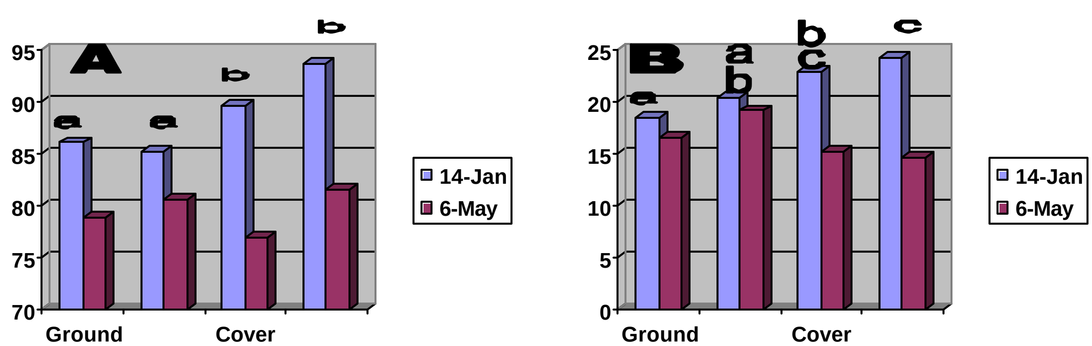

Figure 6. Solidago harvest data. 6A illustrates the harvest height (cm) of the solidago at the winter and spring harvests. 6B illustrates the weight in grams of the solidago at the winter and spring harvests.

Appendix III Tables

Table 1. Mean Number of Insects per Three Leaves (top, middle, and bottom) of randomly selected chrysanthemum plants.

Treatment	Mean # Aphids*	Mean # Whiteflies*	Mean # Leafminers*
Ground	3.7 a	3.9 a	5.6 a
Reflective Mulch	1.1 a	6.1 ab	5.0 a
Reflect Plant Cover	11.3 b	7.7 b	4.6 a
Dark Mulch	2.6 a	8.9 b	4.6 a
Reflective Plant Cover and Reflective Mulch	1.3 a	13.4 c	4.5 a

*Means followed by the same letter in the same column are not significantly different, *P*=0.05

Table 2. Average values for monthly environmental measurements in chrysanthemum trial.

Treatment	**Soil Temperature °F***	**Ambient Air Temperature °F**	**Light Transmission**	**Plant Quality Index***
Ground	**60.6 a**	**70.0**	**1480**	**2.5 a**
Reflective Cover	**60.3 a**	**72.0**	**930**	**3.2 b**
Dark Mulch	**64.3 c**	**72.6**	**1380**	**3.8 c**
Reflective Mulch	**62.9 b**	**71.8**	**1270**	**3.9 cd**
Reflective Mulch + Cover	**63.4 c**	**71.4**	**990**	**4.4 d**

Means followed by the same letter in the same column are not significantly different, *P*=0.05

Table 3. Chrysanthemum harvest data.

Treatment	**Height (cm)***	**Fresh Weight (gm)**	**Dry Weight (gm)**	**# Flowers**	**Flower Caliper (cm)**
Ground	97.0 a	230.2	51.5	38.6	1.83
Reflectiv Plant Cover	106.6 b	244.2	54.6	39.1	1.84
Reflective Mulch	111.5 bc	240.0	58.5	36.0	1.77
Dark Mulch	116.4 cd	248.3	55.4	35.5	1.68
Reflective Mulch + Cover	118.7 d	276.4	61.5	40.7	1.78

* Means followed by the same letter are not significantly different, *P*=0.05.

Table 4. Effects of trap color on number of insects captured. Mean number of insects per trap per 24 hour sample*

Trap Color	Thrips Adults	Leafminer Adults	Whitefly Adults	Aphid Adults	Fungus Gnat Adults
Blue	1.7 a	0.6 a	16.9 a	1.8 a	1.9 a
Pink	0.8 b	1.1 a	21.3 a	2.4 a	1.8 a
Yellow	0.7 b	3.0 b	76.3 b	3.5 a	2.0 a

*Means followed by the same letter in the same column are not significantly different, *P*=0.05.

Table 5. Presentations in which this information was disseminated.

Date	Event	Target Audience	Attendance
6/7/01	Evaluation of the Efficacy and Economic Feasibility of Reflective Mulch in Flower Crops (CORF workshop in Nipomo)	Growers, PCAs	100
7/25/01	Bilingual Scout Training	Growers, workers	71
10/2/01	Pests and Vector Management (CORF)	Growers, PCAs	57
1/24/02	IPM Strategies for Ornamental Crops (PAPA seminar)	Growers, applicators PCAs	155
2/24/02	Scouting Tools and Techniques at workshop for Society of American Florists Insect and Disease Management Conference	Growers, PCAs, Educators	120
2/25/02	Reflective Mulch Trials/Resistance Management on Tour for Society of American Florists Insect and Disease Management Conference	Growers, PCAs, Educators	213
3/5/02	Novel IPM for Ornamental Crops, (included Resistance Management Strategies) Mira Costa College	Growers, PCAs, Applicators	28
6/5/02	Update on Ornamental IPM Strategies (CAPCA)	PCAs	81
6/16/02 - 6/19/02	Presented 2 posters @ Pacific Branch Entomological Society of America Conference	Entomologists, PCAs	65
6/26/02	IPM for Field Grown Flowers @ California Ornamentals Research Federation (CORF) Growers School	Growers, PCAs	60
Scheduled: 10/20/02 – 10/22/02	Presenting 2 posters @ CAPCA Statewide Conference	PCAs	140
10/30/02	Presenting 2 posters @ CORF tour	Growers, PCAs	45
11/21/02	Invited paper at Thrips/Tospovirus Informal Conference, ESA National Meeting in Ft. Lauderdale, FL	Entomologists, PCAs	100